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Segment 07-15-03

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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October 12, 1992

TO: Fran Solomon
Toxics Cleanup Program, NWRO

FROM: Jim Cubbage
Toxics, Compliance and Ground Water Investigations Section, EILS

SUBJECT: Bremerton Storm Drain Sampling Progress Report

The purpose of this progress report is to describe the results of sediment sampling you, Gay and I conducted on June 22-23, 1992, from storm drains in Bremerton. Out of the 24 samples originally planned to be collected, we found suitable samples in seven drains and one outfall. Consequently, we agreed to examine these data from the sampled storm drains before we design the next stage of sampling to deal with those drains with high loads and those drainages for which we could not get a sample.

INTRODUCTION

Sinclair and Dyes Inlets, which border Bremerton, are considered urban bays and have been intensively studied to determine the distribution of contaminants. The current condition of these two inlets is reviewed as part of the Sinclair and Dyes Inlets Action Program (Tetra Tech, 1988). Several contaminants including mercury and PCBs have been found in high concentrations in sediments from both these bays. As a result of this review, the Sinclair and Dyes Inlets Urban Bay Action Plan (Jacobson and Booth, 1990) recommended collecting data on contaminant levels in sediments in storm drains. These data will be used to determine the types of contaminants found in storm drain systems that are discharging to Sinclair and Dyes Inlets, and to help rank drains for source tracing.

Survey Objectives

The primary objectives of this study are listed below:

- Determine if sediments in Bremerton storm drains that discharge to Sinclair and Dyes Inlets have high concentrations of contaminants.

- Find and rank storm drain systems with high levels of contaminants that will need to be traced to determine the source of contamination.

METHODS

Strategy and Field Collection

The primary strategy of this study was to examine sediments at the point where the storm drains discharge into Puget Sound. Storm lines were selected to represent commercial, residential and industrial uses. No storm drains inside or below the Puget Sound Naval Shipyard were studied. The outfalls were checked for deposition during low tide. Some outfalls had no deposition areas at the point of discharge due to the strong currents in Port Washington Narrows. Other outfalls were so far underwater that their exact location could not be found. In these cases, sediments were sampled in the storm drain pipes at the first accessible point upstream that accumulated sediments. With the help of the City of Bremerton Engineering Department and Street Department, we were able to examine pipes in vaults under 30 storm drain access holes. We did not sample individual catch basins, but rather sought to sample sediments from a system that drained a large area. Figure 1 shows locations of areas we checked and where we were able to sample. Detailed maps of sample locations are also shown in Appendix 1. We were able to collect sediments from seven storm drain systems and one outfall. Analysis included priority pollutant metals, volatile organics (VOAs), semivolatiles, total organic carbon, chlorinated pesticides/PCBs, and grain size distribution. Table 1 shows the analytical methods and laboratories used in this study.

Samples were collected on June 22-23, 1992, with either a stainless steel pivoting scoop attached to a pole or with a stainless steel Ponar grab sampler. Sampling personnel did not enter any manholes to collect samples. To reduce cross-contamination, sampling equipment was cleaned between stations with detergent, nitric acid, deionized water, and acetone. All samples were homogenized in stainless steel beakers, and subsamples poured into priority pollutant clean jars. VOAs were taken directly into VOA containers from the grab samples prior to homogenization.

Quality Assurance

Quality assurance reports appear at the end of this report in Appendix 2. The data are useable with few qualifications. One problem to note is that the grain size was run with the ASTM method rather than the Puget Sound Protocol Method. Thus grain size categories are not completely comparable to other studies. Samples for grain size determination are being re-analyzed.

RESULTS AND DISCUSSION

Conventionals

Figure 2 depicts grain size characteristics of the samples taken. Although the divisions between categories is not standard (see QA section above), the results are usable to discern sand, silt, and clay. Recall that the finer the sediments, the more surface area is available

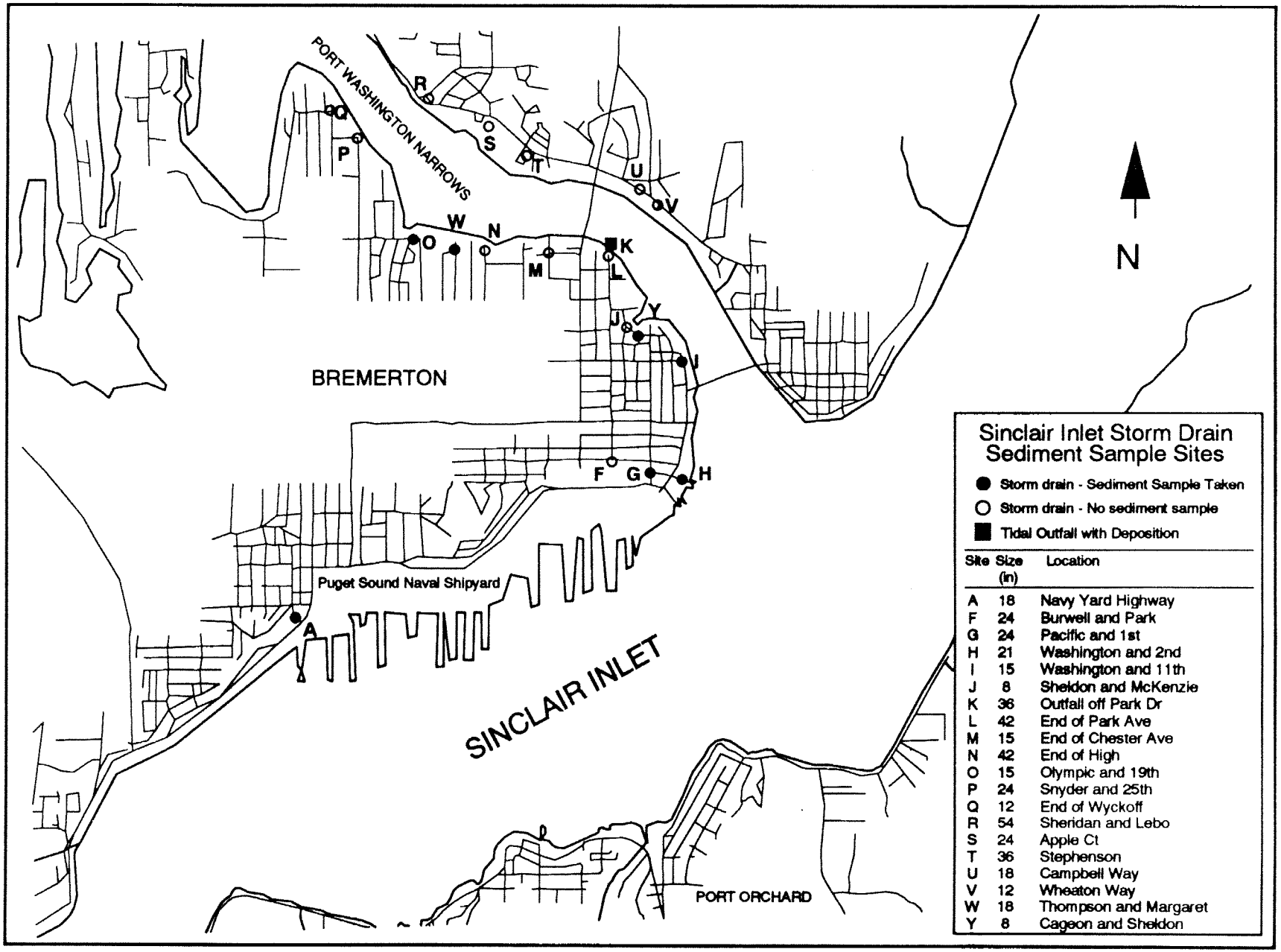

Figure 1. Sites where storm drains were examined and sampled in Bremerton.

Table 1. Analytical methods and laboratories used in Bremerton Storm Drain sediment investigation.

Analysis	Method	Reference	Laboratory
Total organic carbon	Persulfate-UV	APHA 1985	Laucks Testing Labs
Grain size	Seives and pipettes	Holme and McIntyre 1971, EPA 1986a	Laucks Testing Labs
% Moisture	Dry @ 105 degrees C	APHA 1985	Laucks Testing Labs
Antimony	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Arsenic	Atomic Absorption	EPA 1986b	Ecology/EPA (Manchester Lab.)
Berylium	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Cadmium	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Chromium	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Copper	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Mercury	Cold Vapor Atomic Absorption	EPA 1986b	Ecology/EPA (Manchester Lab.)
Lead	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Nickel	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Selenium	Atomic Absorption	EPA 1986b	Ecology/EPA (Manchester Lab.)
Silver	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Thallium	Atomic Absorption	EPA 1986b	Ecology/EPA (Manchester Lab.)
Zinc	Inductively Coupled Argon Plasma	EPA 1986b	Ecology/EPA (Manchester Lab.)
Semivolatiles	GC/MS Method 8270	EPA 1986b	Laucks Testing Labs
Pest/PCB	GC/EC Method 8080	EPA 1986b	Laucks Testing Labs
VOAs	GC/MS Method 8240	EPA 1986b	Laucks Testing Labs

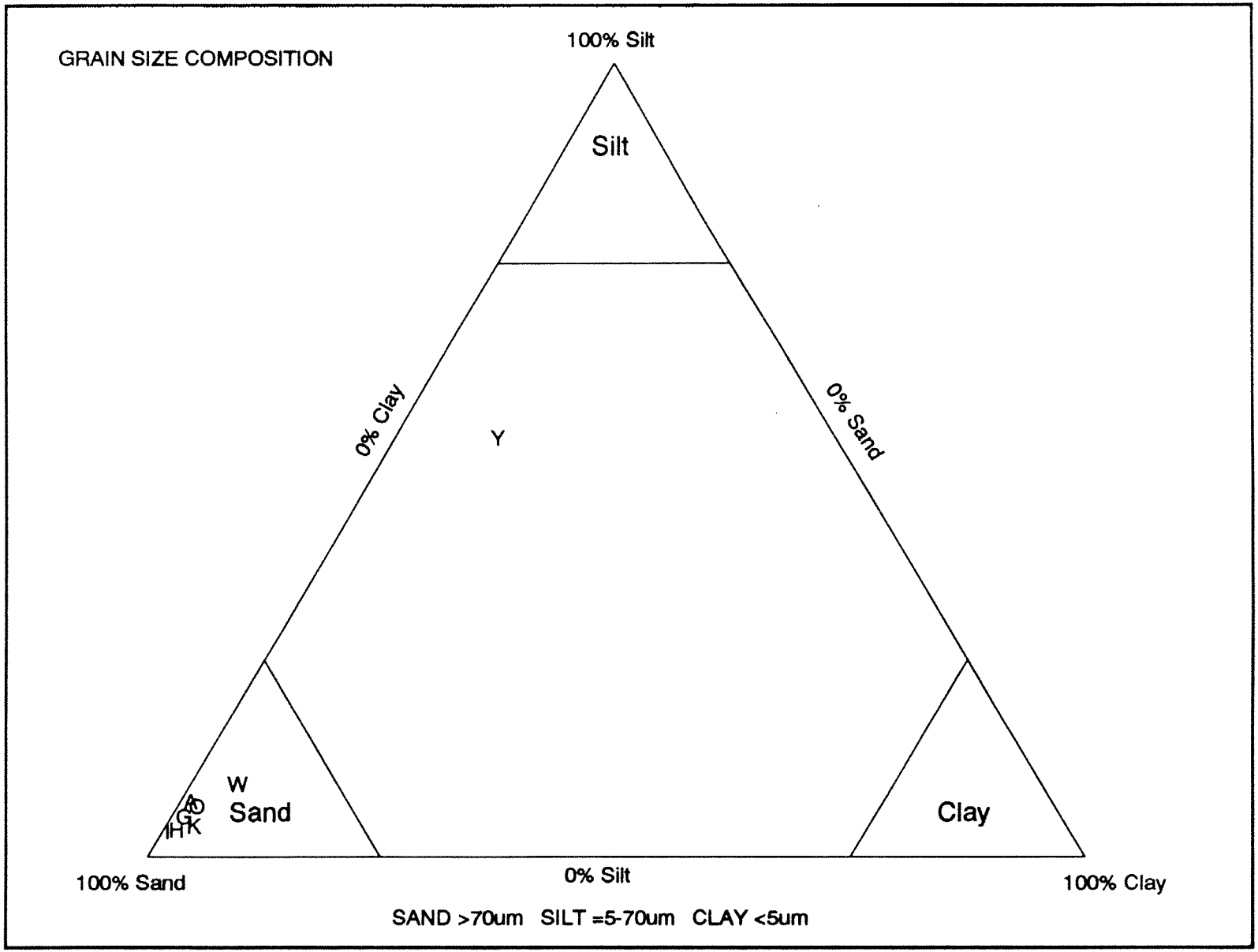

Figure 2. Grain size characteristics of sediments collected in this study. Letters refer to sites.

for contaminants to sorb, thus finer sediments usually have higher contaminant levels. The sediments are quite sandy with the exception of site Y. The presence of coarser grain sediments is consistent with the faster flows associated with steep storm drains systems like those found in eastern Bremerton. TOC concentrations are discussed later.

Metals

Table 2 reviews metals found in the sediments. Of some note are the high concentrations of lead. This is consistent with other studies of urban street dust and most likely has its source in leaded fuel. Zinc is also high and may come from tires. Because these sediments are so sandy, I would expect low concentrations of metals (see Conventionals above). Sites Y and G were high in most metals. Site Y, by the refuse company, was the siltiest sample we took. Site G is in downtown Bremerton and collects runoff from city traffic. Site I also had high concentrations of lead.

No convention exists to normalize metals concentrations for differences in grain size. In other studies I have found strong positive correlations between metals concentrations and percent clay. Figure 3 depicts this relationship for Lake Union, an area that collects urban storm drain discharge, and Bremerton storm drain data. After correction for low percent clay, sites I and G are comparatively high in lead. For measures of lead and zinc, all other sites are consistent with the Lake Union relationship. Thus, though sites I and G are not surprisingly high in lead concentrations, their levels are relatively high when the effects of grain size are considered.

Volatiles

Table 3 reports volatiles found in Bremerton storm drain sediments. Acetone was used to clean tools and thus the levels of acetone reported probably do not reflect concentrations in the environment. The 2-Butanone concentrations may also represent contamination in the analysis. The high concentrations of toluene, ethylbenzene and xylene at site Y indicates some petrochemical input into the system. This may be related to a putative underground storage tank in the area. These chemicals are the major constituents of gasoline. The potential source of the chlorobenzene at site G is unknown. Site W shows some signs of potential gasoline contamination as well. Detection limits for volatile organics that were NOT found in this study are in the Appendix 3.

Semi-Volatile Organics

Table 4 shows the levels of semivolatiles found in sediments. The primary class of chemicals found were PAH (polycyclic aromatic hydrocarbons) and they were detected at all sites. Sites W, H and Y had high concentrations. PAH usually derive from incomplete combustion, but can be associated with oil products as well. Additional heavier chlorobenzenes were found in site G. Pentachlorophenol was found at site Y. The rest of the chemicals found in this scan were primarily phthalates esters (di-n-butyl, butylbenzyl,

Table 2. Metals in sediments from Bremerton storm drains. All values mg/kg dry weight.

Station	O	W	I	H	K	Y	G	A
ample No.	8280	8281	8282	8283	8284	8285	8287	8290
Antimony	15 UN	15 N	15 UN	15 UN	15 UN	15 UN	15 UN	15 UN
Arsenic	2.7	3.6	6.9	3.7	2.0	8.4	8.4	2.5
Berylium	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	1 U	1 U	1 U	1 U	1 U	3.8 P	1.5 P	1 P
Chromium	21	21	23	19	20	59	24	20
Copper	41	84	32	44	28	150	84	40
Lead	114	27 P	339	94	52	390	405	84
Mercury	0.052	0.041	0.019	0.034	0.12	0.45	0.59	0.057
Nickel	32 P	28 P	31 P	30 P	25 P	57	41	25 P
Selenium	0.32 P	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Silver	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Thallium	0.25 UNJ	0.25 UNJ	0.25 UNJ	0.25 UNJ	0.25 UNJ	0.25 UNJ	0.25 UNJ	0.25 UNJ
Zinc	165	203	170	230	115	560	377	130

Shade = Found above detection limit.

Qualifiers

P = Metal found above detection limit but below quantification limit.

U = Detection limit

J = Estimate

N = Presumptive evidence material is present in sample.

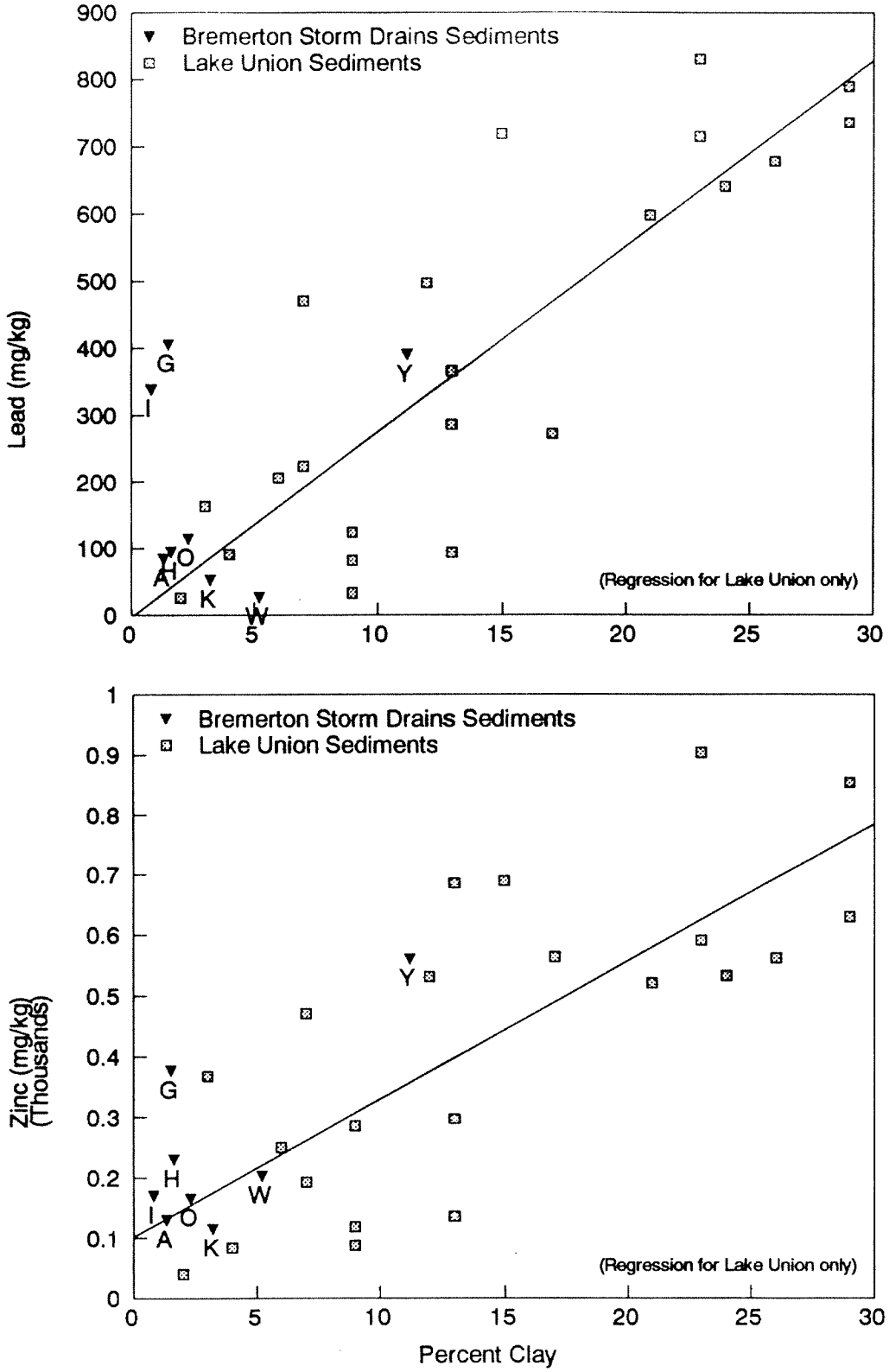

Figure 3. Relationship of percent clay to metals concentrations. Note sites I and G have comparably high levels of lead for their low percent clay based on Lake Union data.

Table 3. Volatiles found in sediments from Bremerton storm drains (μg/kg dry weight).

Station	O	W	I	H	K	Y	G	A
Sample No.	8280	8281	8282	8283	8284	8286	8287	8290
Methylene Chloride	5 UJ	16 UJ	6 UJ	2 UJ	6 UJ	43 UJ	5 UJ	6 UJ
Acetone	14 U	120	3 UJ	88	260	290	99	81
2-Butanone	4 J	38	12 U	13 U	14 U	24 J	14 U	2 J
Benzene	14 U	5 J	12 U	13 U	14 U	120 U	14 U	13 U
Toluene	100	18 J	12 U	13 U	14 U	2500	4 J	13 U
Chlorobenzene	14 U	27 U	12 U	13 U	14 U	120 U	100	13 U
Ethylbenzene	14 U	5 J	12 U	13 U	14 U	47 J	14 U	13 U
Styrene	14 U	52	12 U	13 U	14 U	120 U	14 U	13 U
Xylene	14 U	13 J	1 J	13 U	14 U	145 J	6	13 U

Shade = Found above detection limit

Qualifiers

U = Detection limit

J = Estimate

Table 4. Semi-volatiles found in sediments from Bremerton storm drains (μg/kg dry weight).

Station	O	W	I	H	K	Y	G	A
Sample No.	8280	8281	8282	8283	8284	285-86	8287	8290
1,4-Dichlorobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	45 J	2100 U
1,2-Dichlorobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	29 J	2100 U
2-Methylphenol	3100	510 J	410 U	2200 U	900 U	1700 U	900 U	2100 U
4-Methylphenol	2300 U	4500 U	410 U	2200 U	900 U	470 J	900 U	2100 U
Dimethyphthalate	2300 U	140000	460	2200 U	900 U	53 J	900 U	2100 U
Dibenzofuran	2300 U	290 J	410 U	79 J	10 J	1700 U	73 J	2100 U
N-Nitrosodiphenylamine	2300 U	4500 U	410 U	2200 U	21 J	1700 U	900 U	2100 U
Pentachlorophenol	5500 U	11000 U	990 U	5300 U	2200 U	540 J	2200 U	5100 U
Carbazole	2300 U	1300 J	410 U	780 J	37 J	360 J	100 J	2100 U
Di-n-butylphthalate	66 UJ	320 UJ	35 UJ	44 UJ	59 UJ	870 J	58 UJ	74 UJ
Butylbenzylphthalate	490 J	63000	130 J	81 J	40 J	1700 U	360 J	490 J
bis(2-Ethylhexyl)phthalate	7300	3300	940	1200 J	560 J	16000	4600	1500 J
Di-n-octylphthalate	2300 U	900 J	110 J	2200 U	900 U	1100 J	260 J	140 J
				170	41 U	41 U	70	12 J
PAH								
Napthalene	2300 U	200 J	12 J	2200 U	900 U	260 J	54 J	2100 U
2-Methylnapthalene	32 J	400 J	10 J	2200 U	900 U	640 J	45 J	2100 U
Acenaphthylene	2300 U	4500 U	410 U	61 J	12 J	1700 U	230 J	2100 U
Acenaphthene	2300 U	470 J	410 U	110 J	17 J	1700 U	100 J	2100 U
Fluorene	2300 U	630 J	12 J	160 J	26 J	430 J	160 J	2100 U
Phenanthrene	78 J	7200	120 J	4000	310 J	2100 J	1200	180 J
Anthracene	2300 U	570 J	410 U	500 J	62 J	1700 J	140 J	2100 U
SUM LPAH	110 J	9500 J	150 J	4800 J	430 J	5100 J	1900 J	180 J
Fluoranthene	94 J	9800	120 J	8100	460 J	2600 J	1200	150 J
Pyrene	150 J	7600	150 J	5800	500 J	2800 J	1500	180 J
Benzo(a)anthracene	2300 U	3500 J	46 J	2700	220 J	940 J	580 J	97 J
Chrysene	160 J	3700 J	66 J	3400	260 J	1300 J	520 J	130 J
Benzo fluoranthenes	470 J	6500	410 U	7700	400 J	2100 J	930 J	2100 U
Benzo(a)pyrene	2300 U	3100 J	47 J	3700	230 J	890 J	520 J	2100 U
Ideno(1,2,3-cd)pyrene	2300 U	1500 J	410 U	2400	150 J	330 J	390 J	2100 U
Dibenz(a,h)anthracene	2300 U	800 J	410 U	650 J	64 J	1700 U	130 J	2100 U
Benzo(g,h,i)perylene	2300 U	1200 J	410 U	1500 J	120 J	310 J	400 J	2100 U
SUM HPAH	870 J	38000 J	430 J	36000 J	2400 J	11000 J	6200 J	560 J
SUM PAH (Dry wt. basis)	980 J	47000 J	580 J	41000 J	2800 J	16000 J	8100 J	740 J

Shade = found above detection limits.

Qualifiers

U=Not found at detection limit shown.

J=Estimated due to low signal to noise ratio.

bis(2-ethylhexyl), and di-n-octyl). These compounds appear often in the environment as byproducts of plastics manufacturing and handling. Site W had high concentrations of the butylbenzyl phthalate ester. Those sites with the lowest overall concentrations of organic chemicals were site I and site A. Detection limits for semi-volatile organics that were NOT found in this study are in the Appendix 3.

Pesticides and PCBs

Table 5 shows concentrations of pesticides and PCBs at the sites. Most chlorinated pesticide concentrations are low, but the wide variety of different compounds found is somewhat of a surprise. Site O had the most pesticides followed by site Y. Pesticides found included DDT and its metabolites, BHC, dieldrin, aldrin, and chlordane. Sites H, G and A all had Aroclor 1254, a PCB. Detection limits for pesticides and PCBs NOT found in this study are shown in the Appendix 3.

Comparison to Standards

The Department of Ecology has issued standards for some contaminants in sediments in an attempt to protect biota from harm by contaminants. Metals standards are based on dry weight concentrations. Most organics are corrected by the total organic carbon in the sediments to become milligrams of compound per kilogram of organic carbon. Because all sediments in storm drains will eventually be discharged into Puget Sound, the sediment examined in this study were compared to the marine sediment standards and are shown in Table 6. For metals, site Y exceeded mercury and zinc standards. Site G, near downtown, exceeded only mercury. These two sites approached the limit of lead. Phenols were exceeded at three sites with site Y exceeding pentachlorophenol standards. All sites exceeded at least one phthalate standard. Site H exceeded the PCBs standard. Sites W and H exceeded several PAH standards.

SUMMARY

Most of the storm drains investigated did not have deposition of sediment. Sediments found were primarily sandy. Different areas had different contaminants. Table 7 reviews contaminants found at different sites. All sites had phthalates and PAH and several metals. All sites exceeded at least one marine sediment criteria. Five out of eight sites had chemicals other than phthalates that exceeded standards and thus exceed the levels where there are presumed to be no adverse biological effects if discharged into Puget Sound.

Table 5. Pesticides found in sediments from Bremerton storm drains (μg/kg dry weight).

Station	O	W	I	H	K	Y	G	A
Sample #	8280	8281	8282	8283	8284	8285-86	8287	8290
alpha-BHC	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	1.4 J	2.2 U	2.3 U
gamma-BHC (Lindane)	2.3 U	12.0 P	2.1 U	2.1 U	2.1 U	2.1 U	2.2 U	2.3 U
Heptachlor	1.1 J	3.4 JP	2.1 U	2.1 U	2.1 U	2.1 U	2.2 U	2.3 U
Aldrin	1.2 J	1.8 JP	2.1 U	2.1 U	2.1 U	2.1 U	1.8 J	2.3 U
Heptachlor Epoxide	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	0.86 J	2.2 U	2.3 U
Dieldrin	31	8.9 U	4.1 U	4.1 U	4.1 U	3.5 J	4.3 U	4.5 U
4,4'-DDE	2.0 J	8.9 U	4.1 U	4.1 U	4.1 U	4.8 P	4.3 U	4.5 U
Endrin	4.5 U	8.9 U	4.1 U	4.1 U	4.1 U	7.3 P	4.3 J	4.5 U
Endosulfan II	4.5 U	8.9 U	4.1 U	9.5	4.1 U	4.1 U	4.3 U	4.5 U
4,4'-DDD	2.6 J	8.9 U	4.1 U	4.1 U	4.1 U	12 P	4.3 U	4.5 U
4,4'-DDT	8.4	8.9 U	4.1 U	4.1 U	4.1 U	11	4.3 U	3.4 J
Methoxychlor	18 J	46 U	21 U	21 U	21 U	21 U	22 U	23 U
Endrin ketone	5.7 J	5.7 J	4.1 U	4.1 U	4.1 U	2.9 J	4.3 U	2.3 J
alpha-Chlordane	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	7.6 P	2.1 J	2.3 U
gamma-Chlordane	2.3 U	4.6 U	2.1 U	2.1 U	1.0 U	4.2 P	1.5 J	1.1 J
Aroclor-1254	45 U	89 U	41 U	170	41 U	41 U	70	12 J

Shading = Compound found above detection limit.

Qualifiers

U = No compound found at detection limit shown.

J = Value is estimate.

P = Value is above detection limit but below quantification limit.

Table 6. Comparison of concentrations found to Marine Sediment Quality Standards*.

	Marine Sediment Standard	Study Site O	W	I	H	K	Y	G	A
Metals on dry weight basis (mg/kg)									
Arsenic	57	2.7	3.6	6.9	3.7	2.0	8.4	8.4	2.5
Cadmium	5.1	1 U	1 U	1 U	1 U	1 U	3.8 J	1.5 J	1 J
Chromium	260	21	21	23	19	20	59	24	20
Copper	390	41	84	32	44	28	150	84	40
Lead	450	114	27 J	339	94	52	390	405	84
Mercury	0.41	0.052	0.041	0.019	0.034	0.12	0.45	0.59	0.057
Nickel		32 J	28 J	31 J	30 J	25 J	57	41	25 J
Zinc	410	165	203	170	230	115	560	377	130
Phenols on dry weight basis (µg/kg)									
2-Methylphenol	63	3100	510 J						
4-Methylphenol	670						470 J		
Pentachlorophenol	360						540 J		
TOC		3.1%	3.5%	0.9%	1.0%	1.1%	8.6%	3.2%	1.4%
Total Organic Carbon basis (mg/kg OC)									
1,4-Dichlorobenzene	3.1							1.4 J	
1,2-Dichlorobenzene	2.3							0.9 J	
Dimethyphthalate	53						0.62 J		
Dibenzofuran	15		8.3 J		7.9 J	0.91 J		2.3 J	
N-Nitrosodiphenylamine (1	11					1.9 J			
Carbazole			37 J		78 J	3.4 J	4.2 J	3 J	
Di-n-butylphthalate	220	2.0 UJ	9.1 UJ	3.9 UJ	4.4 UJ	5.4 UJ	10 J	1.8 UJ	5.3 UJ
Butylbenzylphthalate	4.9	16 J	1800	14 J	8 J	3.6 J		11 J	35 J
bis(2-Ethylhexyl)phthalate	47	240	94	100	120 J	51 J	190	140	110 J
Di-n-octylphthalate	58		26 J	12 J			13 J	8 J	10 J
Total PCBs	12				17			2	1 J
PAH									
Napthalene	99		5.7 J	1.3 J			3.0 J	1.7 J	
2-Methylnapthalene	38	1.0 J	11 J	1.1 J			7.4 J	1.4 J	
Acenaphthylene	66				6 J	1.1 J		7.2 J	
Acenaphthene	16		13 J		11 J	1.5 J		3.1 J	
Fluorene	23		18 J	1.3 J	16 J	2.4 J	5.0 J	5.0 J	
Phenanthrene	100	2.5 J	210	13 J	400	28 J	24 J	38	13 J
Anthracene	220		16 J		50 J	5.6 J	20 J	4.4 J	
Total LPAH	370	3.5 J	270 J	17 J	480 J	39 J	59 J	61 J	13 J
Fluoranthene	160	3.0 J	280	13 J	810	42 J	30 J	38	11 J
Pyrene	1000	4.8 J	220	17 J	580	45 J	33 J	47	13 J
Benzo(a)anthracene	110		100 J	5.1 J	270	20 J	11 J	18 J	6.9 J
Chrysene	110	5.2 J	110 J	7.3 J	340	24 J	15 J	16 J	9.3 J
Benzo fluoranthenes	230	15.2 J	190		770	36 J	24 J	29 J	
Benzo(a)pyrene	99		89 J	5.2 J	370	21 J	10 J	16 J	
Ideno(1,2,3-cd)pyrene	34		43 J		240	14 J	3.8 J	12 J	
Dibenz(a,h)anthracene	12		23 J		65 J	5.8 J		4.1 J	
Benzo(g,h,i)perylene	31		34 J		150 J	11 J	3.6 J	13 J	
Total HPAH	960	28 J	1100 J	48 J	3600 J	220 J	130 J	190 J	40 J

*=Sediment Management Standards; Chapter 173-204 WAC; WA Dept of Ecology

Outlined box = exceeds sediment standards.

Qualifiers

U=Not found at detection limit shown.

J=Estimated value.

Table 7. Review of contaminants found at different sites. Metals were found at all sites.

Site	Contaminants exceeding standards	Other Organic Contaminants	Location and Comments
O	2-Methylphenol, phthalates (butylbenzyl, bis(2-ethylhexyl) esters)	Had the most kinds of chlorinated pesticides, PAH	Residential
W	2-Methylphenol, HPAH, phenanthrene, phthalates (butylbenzyl, bis(2-ethylhexyl) esters)	Had the most kinds of volatiles, benzene found, lindane, heptachlor, aldrin, PAH	Near culvert factory - not now connected to Puget Sound - will become storm drain. Mostly Industrial
I	Phthalates (butylbenzyl, bis(2-ethylhexyl) esters)	Xylene at detection limit, PAH	Residential
H	Aroclor 1254(PCB), HPAH, phenanthrene, phthalates (butylbenzyl, bis(2-ethylhexyl) esters)	Endosulfan II at low level, PAH	Below downtown Bremerton. Commercial
K	Phthalate (bis(2-ethylhexyl) esters)	PAH	Intertidal outfall at end of Park Ave. Residential
Y	Mercury, zinc, pentachlorophenol, phthalate (bis(2-ethylhexyl) ester)	Highest toluene, ethylbenzene, and xylene; endrin, DDE, DDT, alpha-BHC, PAH	Adjacent to garbage disposal company. Light industrial, residential
G	Mercury, phthalates (butylbenzyl, bis(2-ethylhexyl) esters)	Aldrin, PCB, chlordane, chlorobenzenes,PAH	Adjacent above shipyard, downtown Bremerton. Commercial
A	Phthalates (butylbenzyl, bis(2-ethylhexyl esters)	DDT, endrin, chlordane, PCB	Residential, commercial area.

RECOMMENDATIONS

Followup to this work:

The basins that should have further examination to determine sources of contamination are

O (Pesticides)
W (Pesticides, PAH, butylbenzylphthalate)
H (PCBs, PAH (may be from urban street dust from cars))
Y (VOAs, Mercury, Zinc, Pentachlorophenol, Pesticides)

Storm drains that empty into these sites should be examined. Businesses should be checked for discharges.

Additional new directions:

We need to find a solution to the problems we found in trying to sample storm drains for sediment. We have discussed potential long-range solutions including sediment traps that can be deployed in storm drains. A short range compromise may be to sample storm water over a period with ISCO composite samplers or manual grab samples. Another possibility is to use the centrifuge van and sample sediment within the storm water during a storm. We need to meet and discuss these possible solutions.

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Jacobson, M.A. and P.N. Booth, 1990. Sinclair and Dyes Inlets urban bay action program: 1990 Action Plan. PTI report prepared for US EPA Region 10, Office of Puget Sound.

Tetra Tech, 1988. Sinclair and Dyes Inlets action program: Initial data summaries and problem identification. Final Report prepared for US EPA Region 10, Office of Puget Sound.

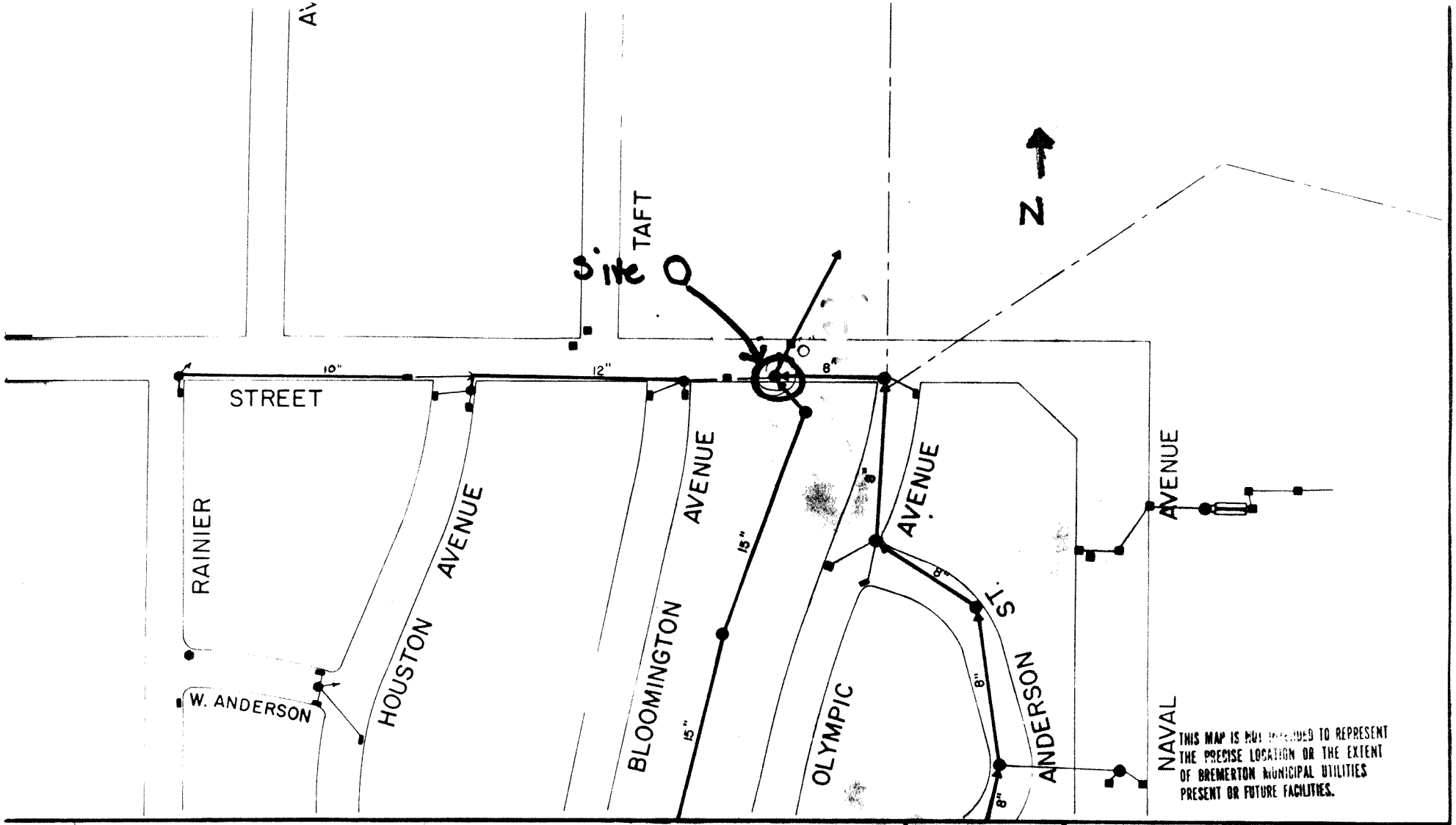
Washington State Department of Ecology, 1991. Sediment Management Standards. Washington Administrative Code Chapter 173-204.

APPENDICES

1. VICINITY MAPS OF SITES

2. LABORATORY QUALITY ASSURANCE REVIEWS

3. DETECTION LIMITS FOR ORGANICS ANALYSES FOR COMPOUNDS NOT FOUND ABOVE DETECTION LIMITS IN THIS STUDY.

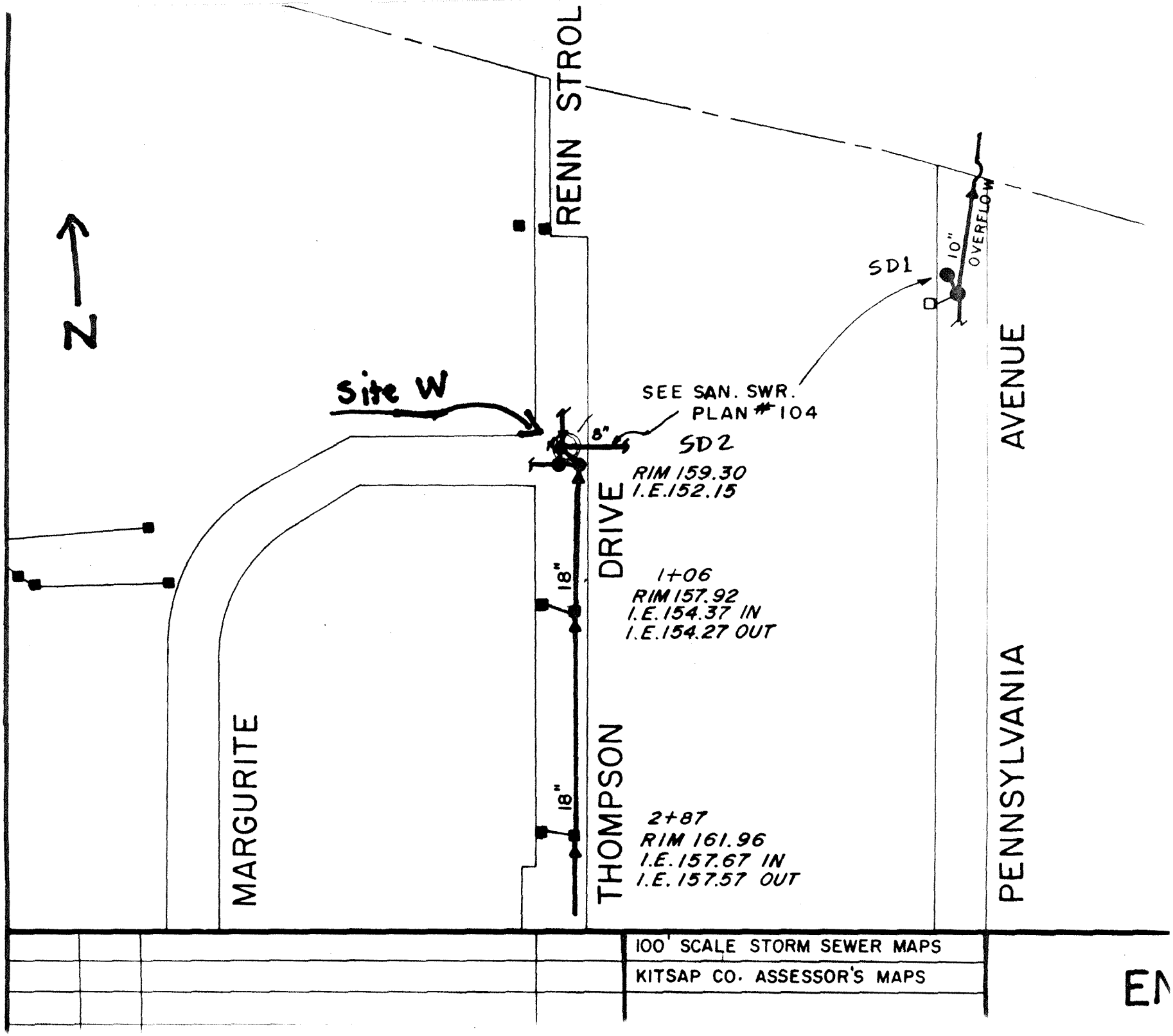


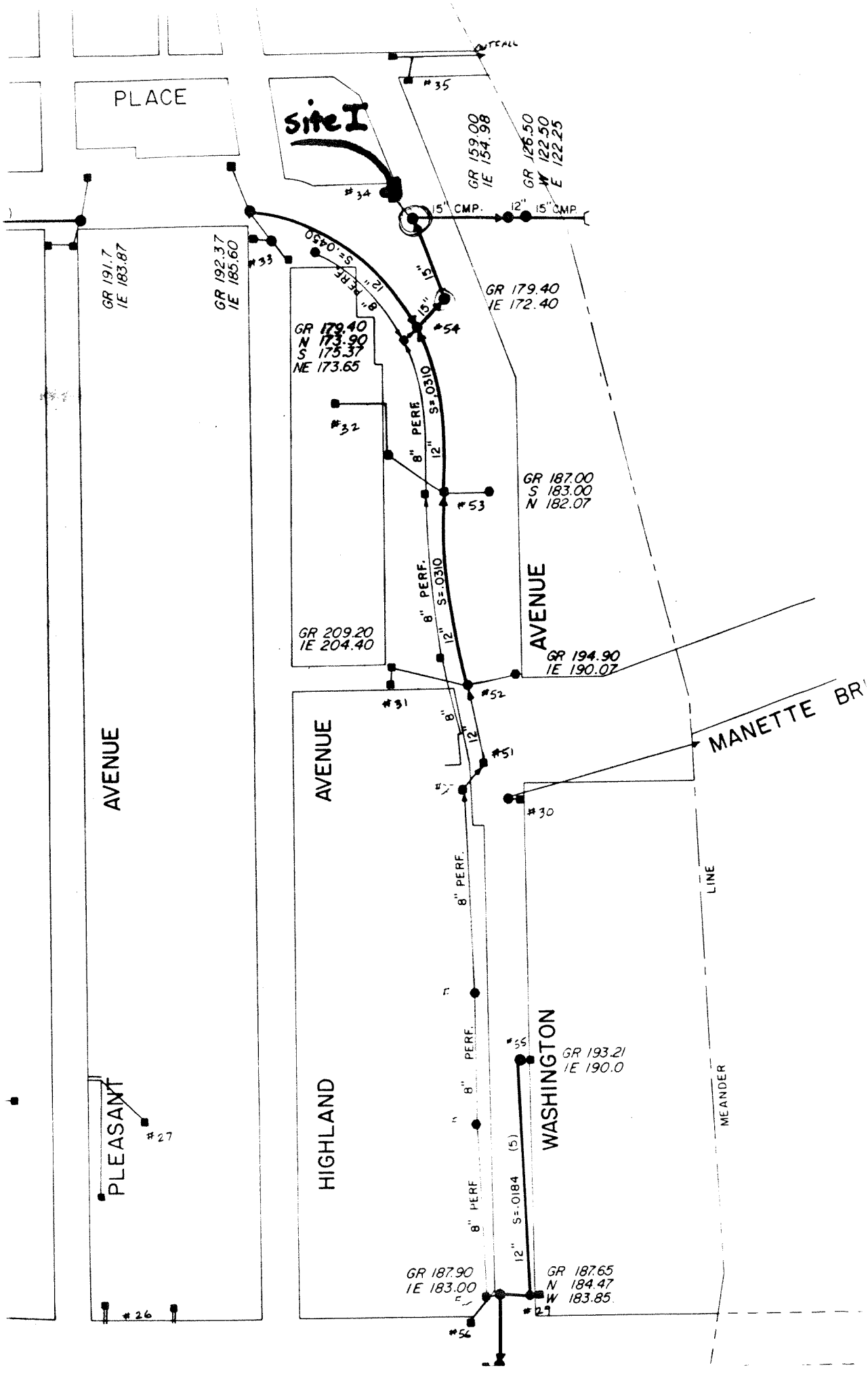
ORM WATER SYSTEM

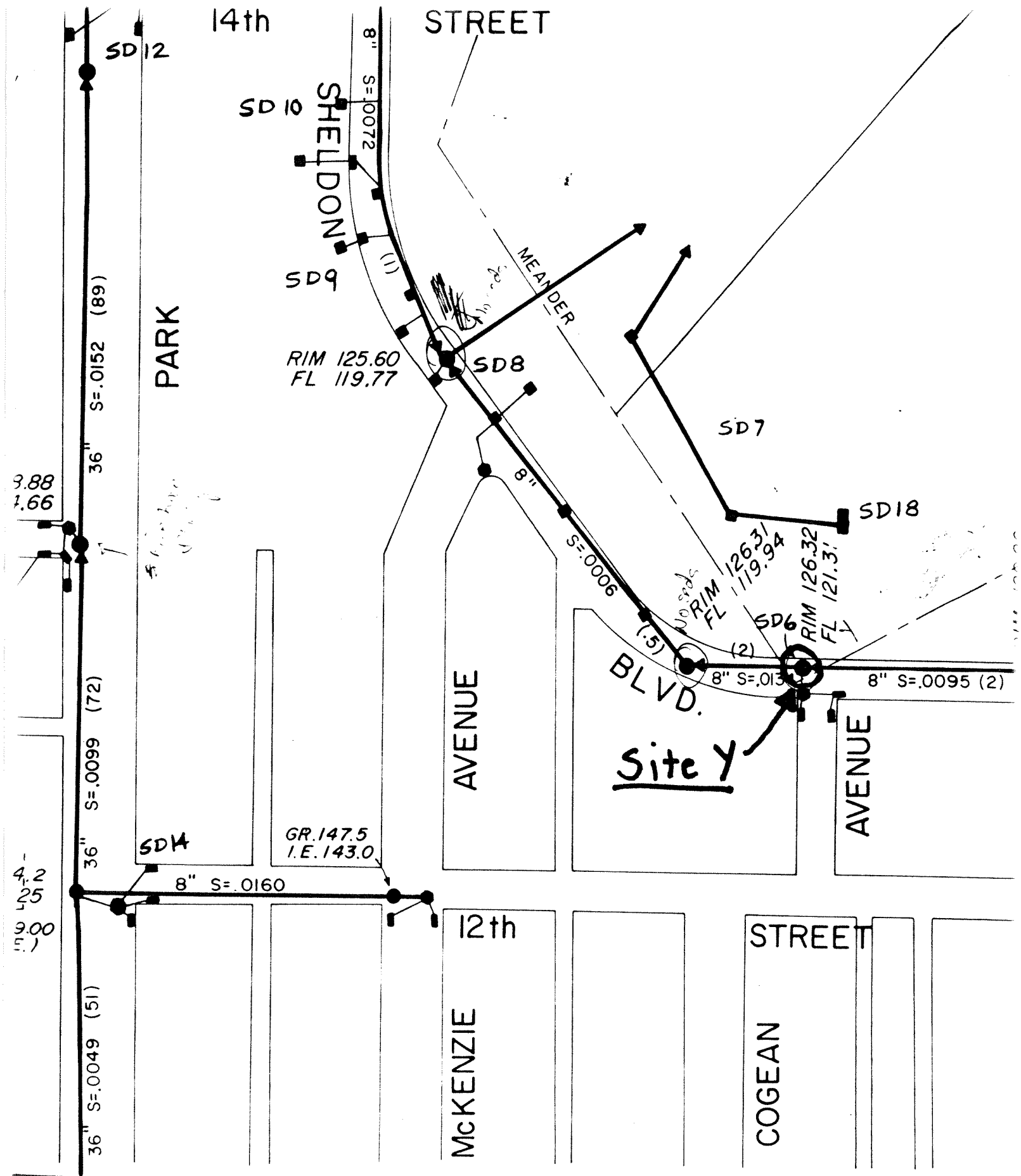
1" = 100'	
DATE	
FILE NO.	

113
114 + 104
111

112


RENN STROL
AVENUE
PENNSYLVANIA
DRIVE
THOMPSON
MARGURITE
N
Site W
SD1
10" OVERFLOW
SEE SAN. SWR. PLAN # 104
8"
SD2
RIM 159.30
I.E.152.15
18"
1+06
RIM 157.92
I.E.154.37 IN
I.E.154.27 OUT
18"
2+87
RIM 161.96
I.E.157.67 IN
I.E.157.57 OUT
100' SCALE STORM SEWER MAPS
KITSAP CO. ASSESSOR'S MAPS

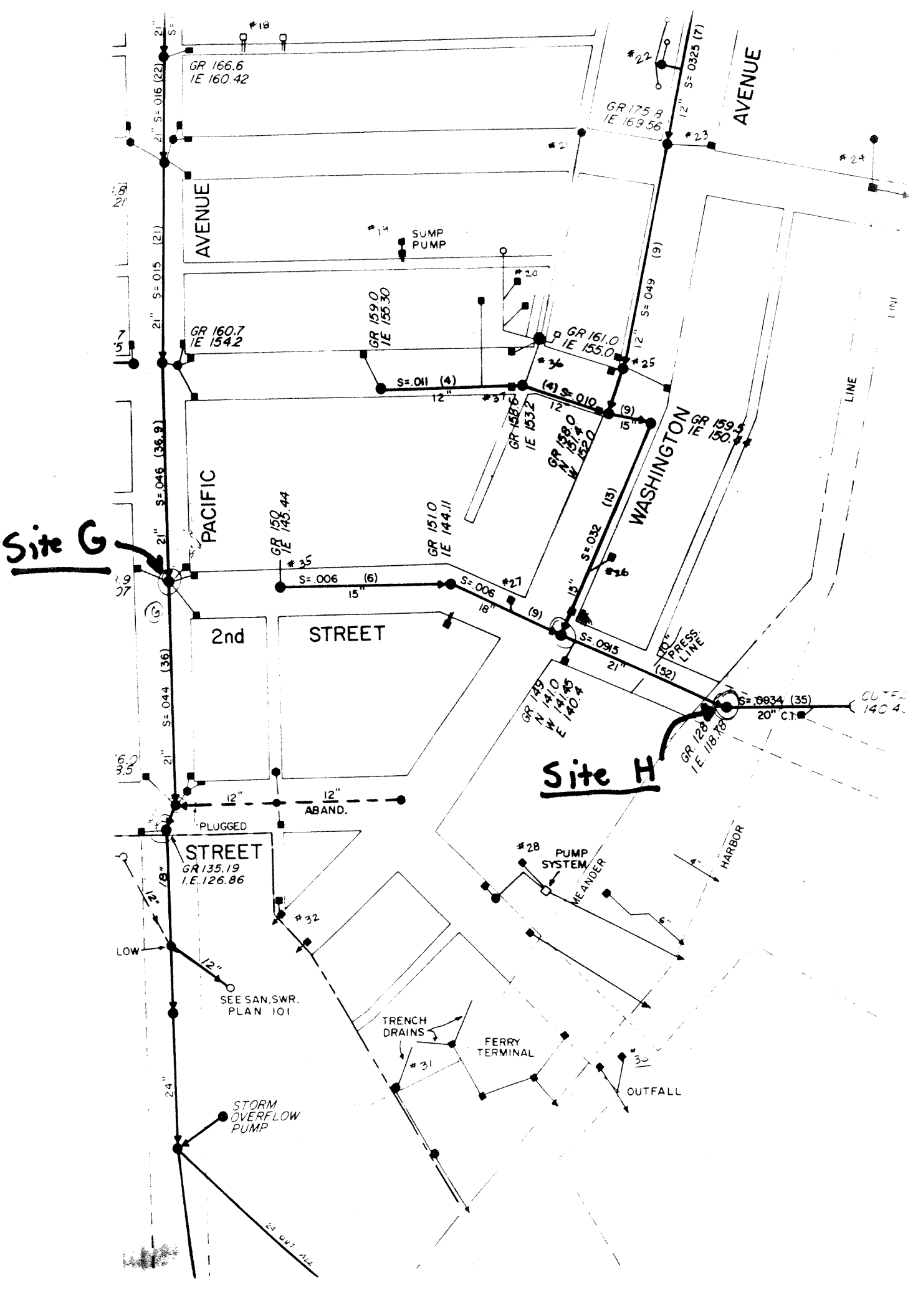

PLACE
site I
#35
GR 159.00
IE 154.98
GR 126.50
W 122.50
E 122.25
#34
15" CMP.
12" 15" CMP
GR 191.7
IE 183.87
GR 192.37
IE 185.60
#33
S=.0450
12"
8" PERF
15"
GR 179.40
IE 172.40
#54
GR 179.40
N 173.90
S 175.37
NE 173.65
#32
8" PERF.
S=.0310
12"
GR 187.00
S 183.00
N 182.07
#53
AVENUE
GR 209.20
IE 204.40
GR 194.90
IE 190.07
#31
#52
MANETTE BR
#51
#30
AVENUE
AVENUE
8" PERF.
LINE
#55
GR 193.21
IE 190.0
WASHINGTON
HIGHLAND
PLEASANT
#27
8" PERF.
12" S=.0184 (5)
MEANDER
GR 187.90
IE 183.00
GR 187.65
N 184.47
W 183.85
#29
#26
#56

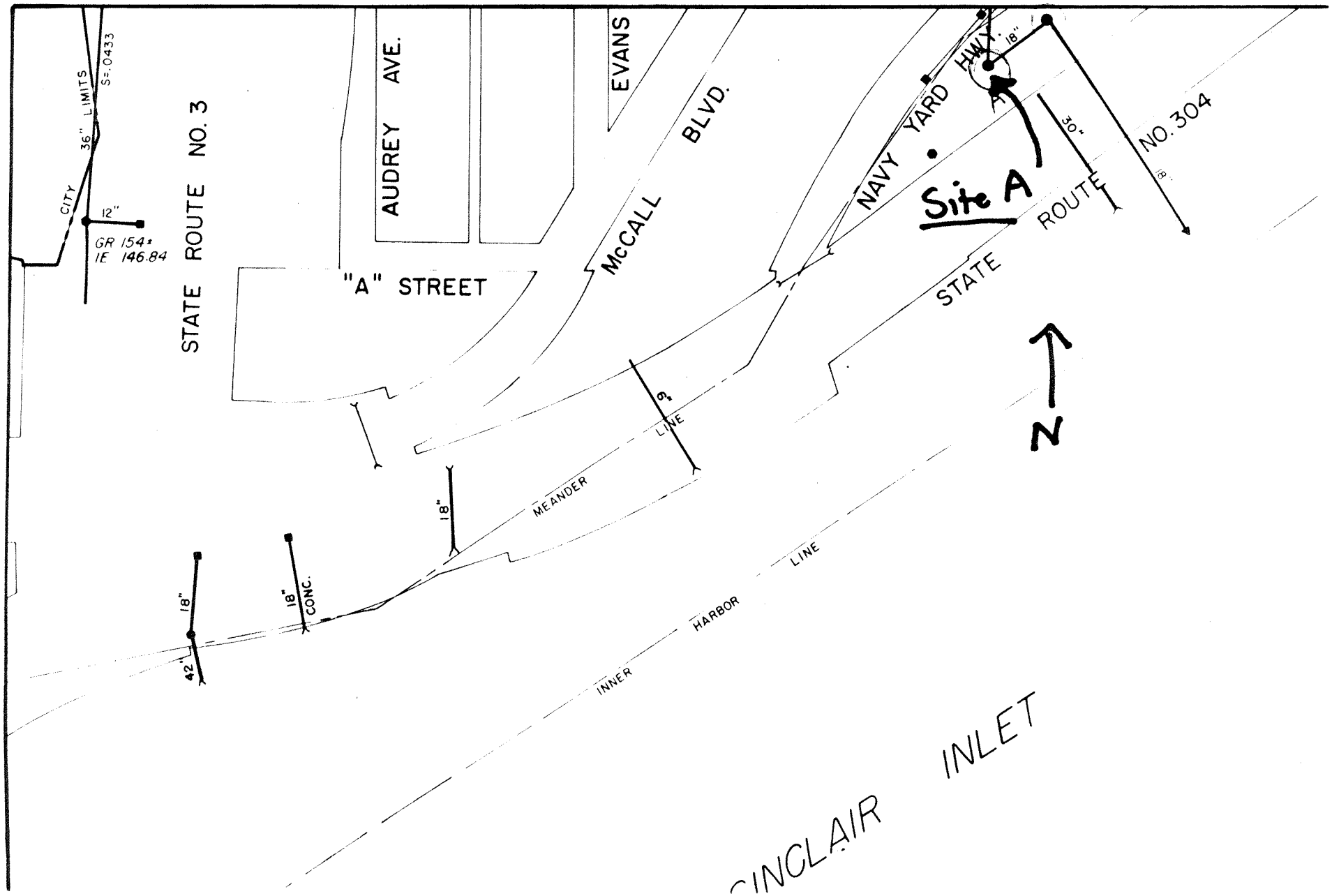


	ENGR. SEWER CARDS
	100' SCALE STORM SEWER MAPS
	C.B. FIELD MEAS. / NOTES

ENGINEERING DEPA

CITY of BREM


Site G
Site H
PACIFIC AVENUE
WASHINGTON AVENUE
2nd STREET
STREET
GR 166.6
IE 160.42
GR 175.8
IE 169.56
GR 160.7
IE 154.2
GR 159.0
IE 155.30
GR 161.0
IE 155.0
GR 158.6
IE 153.2
GR 158.0
IN 151.4
W 152.0
GR 159.5
IE 150.7
GR 150
IE 145.44
GR 151.0
IE 144.11
GR 149
IN 141.0
W 141.45
E 140.4
GR 128
IE 118.78
S= 016 (22)
S= 015 (21)
S= 046 (36.9)
S= 044 (36)
S= 011 (4)
S= 010 (4)
S= 049 (9)
S= 032 (13)
S= .006 (6)
S= .006
S= 0915 (52)
S= 0834 (35)
S= 0325 (7)
12"
15"
18"
21"
20" C.I.
#18
#19
#20
#21
#22
#23
#24
#25
#26
#27
#28
#30
#31
#32
#35
#36
SUMP PUMP
PRESS. LINE
12" ABAND.
PLUGGED
GR 135.19
I.E. 126.86
PUMP SYSTEM
MEANDER
HARBOR
LOW
SEE SAN. SWR. PLAN 101
TRENCH DRAINS
FERRY TERMINAL
OUTFALL
STORM OVERFLOW PUMP
24" OUTFALL
LINE


STATE ROUTE NO. 3
AUDREY AVE.
EVANS
McCALL BLVD.
NAVY YARD
HWY.
18"
Site A
30"
NO. 304
18"
ROUTE
STATE
"A" STREET
CITY
36" LIMITS
S=.0433
12"
GR 154±
IE 146.84
9±
LINE
MEANDER
18"
18"
CONC.
42"
HARBOR
LINE
INNER
N
INLET

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES
MANCHESTER LABORATORY

July 27, 1992

TO: Project officer

FROM: despina Strong

SUBJECT: Sinclair Inlet Metals Data

SAMPLE RECEIPT:

The samples from the Sinclair Inlet project were received by the Manchester Laboratory on 6/23/92 in good condition.

HOLDING TIMES:

All analyses were performed within the specified holding times for metals analysis (28 days for mercury, 180 days for all other metals).

INSTRUMENT CALIBRATION:

Instrument calibration was performed before each analytical run and checked by initial calibration verification standards and blanks. Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the analytical run. All initial and continuing calibration verification standards were within the control limits of +/- 10%. AA calibration gave correlation coefficients greater than the criteria of 0.995. A correlation coefficient of 0.995 or higher means that the calibration is acceptable.

PROCEDURAL BLANKS:

The procedural blanks associated with these samples showed no detectable levels of analytes.

SPIKED SAMPLE ANALYSIS:

Spiked sample and duplicate spiked sample analysis were performed on one sample in the batch. All spike recoveries were within the acceptable limits of +/- 25% except for thallium and antimony. This is not unusual for sediment samples. The results are qualified with "N".

PRECISION DATA:

The duplicate results of the spiked and duplicate spiked sample were used to calculate precision related to the analysis of these samples. The % RPD for all parameters was well within the +/- 20% window for duplicate analysis except for thallium and antimony. The analysts used either "E" or "N", "J" to qualify the data.

STANDARD REFERENCE MATERIAL:

Standard reference material or external verification standards were all within the windows established for each parameter.

ICP SERIAL DILUTION ANALYSIS:

The Relative Percent Difference (RPD) between sample results and the results for a serial dilution of the same sample were less than 10% between the 1/5 and 1/25 serial dilutions. The results are reported from the 1/5 dilution.

SUMMARY:

The data generated by the analysis of the above referenced samples can be used with the above mentioned qualifiers.

If you have any questions about the results or the methods used to obtain these results please call me at SCAN 744-4737.

MANCHESTER ENVIRONMENTAL LABORATORY
7411 Beach Drive E , Port Orchard Washington 98366

August 28, 1992

Subject: Sinclair Inlet Storm Drains

Samples: 92 - 268280 to -268287, and -268290

Case No. DOE-363Y

Officer: Jim Cubbage

By: Dickey D. Huntamer
Through: Stuart Magoon

CASE SUMMARY

These analyses were reviewed for qualitative and quantitative accuracy, validity and usefulness. Sample analysis used SW 846 procedures. Specific methods used and problems incurred during the analysis of these samples are detailed in the case narrative and will not be addressed here. Analytical problems associated with QA/QC will be noted and referenced to the case narrative where appropriate.

VOA FRACTION:

Method: SW 846 8240

Matrix: Soil

Holding times:

All samples were extracted and analyzed within the recommended holding times.

Surrogates:

Surrogate recoveries for the samples were acceptable and within QC limits.

Matrix Spike and Matrix Spike Duplicate:

Matrix spike percent recoveries and Relative Percent Differences (RPD) were all within acceptable QC limits.

Sample Data:

The laboratory method blanks, VBLKU1, VBLKU2 and VBLKU3 contained low levels of common laboratory solvents, methylene chloride and acetone. Methylene chloride was detected in blank VBLKU3, acetone in VBLKU2 and both compounds in VBLKU1. The EPA five times rule was applied to all target compounds which were found in the blank. Compounds that were found in the sample were considered real and not the result of contamination if the levels in the sample are five times or greater than the compounds in the method blank. Those compounds which failed this criteria were qualified by adding the "UJ" data qualifier to the result.

SEMIVOLATILE FRACTION:

Method: SW 846 8270

Matrix: Soil

Holding times:

All samples were extracted and analyzed within the recommended holding times.

Surrogates:

Surrogate recoveries for the samples were acceptable and within QC limits.

Matrix Spike and Matrix Spike Duplicate:

Matrix spike percent recoveries and Relative Percent Differences (RPD) were all within acceptable QC limits except for 4-nitrophenol and 2,4-dinitrotoluene. The 4-nitrophenol was 6% over the recommended limit and 2,4-dinitrotoluene was 8% over the limit. The RPD for 1,4-dichlorobenzene was also over the recommended limit. The deviation from the recommended recoveries and RPD were not significant and no additional data qualifiers were added based on spike recoveries.

Sample Data:

The laboratory method blank, SBLKH1 contained, di-n-butylphthalate and bis-ethylhexyl-phthalate. The EPA five times rule was applied to all target compounds which were found in the blank. Compounds that were found in the sample were considered real and not the result of contamination if the levels in the sample are five times or greater than the compounds in the method blank. Those compounds which failed this criteria were qualified by adding the "UJ" data qualifier to the result.

Two compounds benzo(b)fluoranthene and benzo(k)fluoranthene could not be chromotographically resolved in all samples. The "X" flag was used to indicate when this situation occurred.

DATA QUALIFIER DEFINITIONS

U	-	The analyte was not detected at or above the reported value.
J	-	The analyte was positively identified. The associated numerical value is an estimate.
UJ	-	The analyte was not detected at or above the reported estimated result.
REJ	-	The data are unusable for all purposes.
EXP	-	The result is equal to the number before EXP times 10 to the power of the number after EXP. As an example 3EXP6 equals 3×10^6.
NAF	-	Not analyzed for.
N	-	For organic analytes there is evidence the analyte is present in this sample.
NJ	-	There is evidence that the analyte is present. The associated numerical result is an estimate.
E	-	This qualifier is used when the concentration of the associated value exceeds the known calibration range.
D	-	Signifies that the associated value was derived from a secondary dilution.

Note: If this data is entered into some other format an "N" flag should be added to the compounds reported as tentatively identified compounds. The "N" flag indicates that there is presumptive evidence that the analyte is present in this sample.

LAUCKS TESTING LABORATORIES
940 S. Harney
Seattle, WA 98108

TO: Washington State Department of Ecology
Project Name: Sinclair Inlet Storm Drains
Ecology Order No.: F171833
Laboratory No.: 9206E20
Date of this report: July 27, 1992

SAMPLE RECEIPT, IDENTIFICATION, AND GENERAL COMMENTS:

Sample Receipt and Identification:

The samples submitted under the laboratory number(s) indicated above were identified and analyzed as tabulated below. The samples were collected and received on the dates noted on the enclosed chain-of-custody copies, Attachment A.

Client Sample Identification	Laucks Sample Identification	Testing Analytical Request
268280	9206E20-01	VOA/ABN/PEST/PCB/TOC/GRSZ
268281	9206E20-02	VOA/ABN/PEST/PCB/TOC/GRSZ
268282	9206E20-03	VOA/ABN/PEST/PCB/TOC/GRSZ
268283	9206E20-04	VOA/ABN/PEST/PCB/TOC/GRSZ
268284	9206E20-05	VOA/ABN/PEST/PCB/TOC/GRSZ
268285	9206E20-06	VOA/ABN/PEST/PCB/TOC/GRSZ
268286	9206E20-07	VOA/ABN/PEST/PCB/TOC/GRSZ
268287	9206E20-08	VOA/ABN/PEST/PCB/TOC/GRSZ
268290	9206E20-09	VOA/ABN/PEST/PCB/TOC/GRSZ
No sample	9206E20-10	VOA/ABN/PEST/PCB/TOC/GRSZ

Analytical Request Key:

VOA = Volatile Organics
ABN = Semi-Volatile Organics
Pest/PCB = Pesticides/PCBs
TOC = Total Organic Carbon
GRSZ = Grain Size

LAUCKS TESTING LABORATORIES
940 S. Harney
Seattle, WA 98108

Sample Identification on Forms:

When completing forms created through the CLP software, every attempt is made to use both your sample IDs as well as the laboratory sample IDs. The forms have varied default sizes to their sample identification fields, and are not amenable to alteration or editing. When it is not possible to use your complete sample ID because of field length limitations, Laucks will usually do one of two things: 1) use as much of your ID as will fit, beginning from the RIGHT hand side of the sample ID number; or 2) select some sub-set of your sample identifier if it is clearly a discrete number. In addition, ALL forms will contain our sample IDs, which can be cross-referenced from the table above.

Many of the CLP-package forms include the words "EPA Sample No.," or some variation, which again cannot be edited. Where a reference is made to the EPA, you may take this to mean more generally, "the client." These data are not part of an actual EPA case.

GENERAL REMARKS ON ORGANIC ANALYSES:

The following comments describe general analysis conditions. For remarks specific to the samples reported in this case, see "SPECIFIC REMARKS ON ORGANIC ANALYSES."

All GC/MS Fractions:

The computerized printout for sample analysis may tabulate values for target analytes that are not reported on the relevant Form I. In that case, we have manually searched the mass spectral data and have eliminated the compound(s) as reportable based on this search.

The data system that is used to perform the searches for Tentatively Identified Compounds (TICs) is set with a threshold of 5% fit for TICs. In some cases, fewer than three compounds in the NBS library pass this threshold setting. When this occurs there will not be spectra and fits for the associated unknown compound, as called out on the first page of the data system report and reflected in the spectra that are drawn (i.e., there will be less than three best-fit spectra). This generally has one of two meanings. First, that there are no compounds passing the fit criteria; or, second, that one or more compounds pass the fit criteria. It is our opinion that the threshold setting for fit is set low enough that all reasonable and possible "hits" will be reported (up to a maximum of three).

Semi-Volatile Fraction:

All soil/sediment extracts were cleaned using Gel Permeation Chromatography (GPC), as per 03/90 CLP protocols.

Volatile Fraction:

All volatile analyses were performed using a DB-624 megabore capillary. Listed below are the correct elution order and the internal standard with which each compound is associated.

Bromochloromethane (IS)	1,4-Difluorobenzene (IS)	d5-Chlorobenzene (IS)
Chloromethane	Benzene	Cis-1,3-Dichloropropene
Vinyl Chloride	1,2-Dichloroethane	4-Methyl-2-Pentanone
Bromomethane	Trichloroethene	d8-Toluene (SURR)
Chloroethane	1,2-Dichloropropane	Toluene
1,1-Dichloroethene	Bromodichloromethane	Trans-1,3-Dichloropropene
Acetone		1,1,2-Trichloroethane
Carbon Disulfide		Tetrachloroethene
Methylene Chloride		2-Hexanone
Trans-1,2-Dichloroethene		Dibromochloromethane
1,1-Dichloroethane		Chlorobenzene
Cis-1,2-Dichloroethene		Ethylbenzene
2-Butanone		M,P-Xylene
Chloroform		O-Xylene
1,1,1-Trichloroethane		Styrene
Carbon Tetrachloride		Bromoform
d4-1,2-Dichloroethane (SURR)		Bromofluorobenzene (SURR)
		1,1,2,2-Tetrachloroethane

The analytes listed above were assigned to their respective internal standards on the basis of relative retention time (RRT).

Separation of cis- and trans- dichloroethylene isomers is achievable on a DB-624 megabore capillary column. When these isomers are found in a sample, they are reported as total-1,2-dichloroethylene.

Due to the tight band in which the volatile compounds are delivered onto the column, separation of the gases can be achieved without the use of subambient temperatures. It has been noted that the purge and trap, the condition of the trap, and the type of column all play important roles on the affect of the early eluting compounds. With an initial temperature of 30 degrees Celsius, not only can the gases be separated by the ElCP, but also the response factors of the gases are well above the required minimum response factor of 0.1 (for bromomethane and vinyl chloride.) This is demonstrated on Form 6V, where the average response factors vary from 0.4 to 1.0. The reproducibility of the gases is exemplary as shown by the low relative standard deviations on Form 6V and the low percent differences on Form 7V. Bromoform has also been demonstrated to yield response factors well above the minimum RRF of 0.1, as shown on Form 6V, where the average response is greater than 0.6. Given these results, subambient temperatures have not been employed in the volatile analyses.

Pesticide/PCB Fraction:

The compound isodrin was added as a third, optional surrogate in the pesticide/PCB analyses. Recovery values are reported on the appropriate Form II - PEST.

LAUCKS TESTING LABORATORIES
940 S. Harney
Seattle, WA 98108

SPECIFIC REMARKS ON ORGANIC ANALYSES:

Holding Time Compliance:

Following the Contract Laboratory Program (CLP) model, Laucks calculates holding time compliance for organic determinations based on the first injection and/or analysis of an extract or sample. Subsequent analyses (for instance, for the purpose of dilution) are not tabulated.

Volatile Organic Compounds:

The holding time is 10 days calculated from Verified Time of Sample Receipt (VTSR) under the CLP model or 14 days from date of collection in both soil and water samples. All samples were analyzed within holding time.

Semi-Volatile Organic Compounds:

The holding time to extraction is 5 days in water and 10 days in soil calculated from VTSR under the CLP model, or 7 days in water and 14 days in soil calculated from date of collection. In either case, the holding time from extraction to analysis is 40 days. All samples were extracted and analyzed within holding time.

Pesticides/PCBs:

The holding time to extraction is 5 days in water and 10 days in soil calculated from VTSR under the CLP model, or 7 days in water and 14 days in soil calculated from date of collection. In either case, the holding time from extraction to analysis is 40 days. All samples were extracted and analyzed within holding time.

VOA Fraction:

Sample 26-8286 was analyzed as a low-level soil, using 1 gram of sample. Because of the high level of toluene detected in this sample, a dilution was required in order to bring the analyte within linear range of the initial calibration. In order to dilute the sample further, a medium extraction was performed and analyzed. QC was also performed on the medium level sample, per the EPA SOW.

The medium analysis resulted in the detection of a significant TIC that was less than 10% in the low soil and therefore was only reported in the medium soil. This may be due to the very nature of the TIC, extracting out of the methanol more efficiently than when it is purged with water since it hydrolyzes in the presence of water and forms an azeotrope with methanol. This compound, trimethyl ester boric acid, also elutes with methylene chloride. Therefore, the peak height was determined by the ratio of the most abundant ion in comparison to the most abundant ion in methylene chloride, which was approximately one-half of the total peak height since the ratios were approximately 1:1.

Sample 26-8284 also had a TIC that coeluted with a target analyte (acetone). The ratio of the most abundant ion for acetone and the TIC, thiobismethane, was approximately 1:5. Therefore, the TIC was calculated by taking one-fifth the total peak height.

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Seattle, WA 98108

ABN Fraction:

MS/MSD analyses were performed on sample 26-8282. Recovery of 4-nitrophenol and 2,4-dinitrotoluene exceeded recommended control limits in the MS analysis. The RPD for 1,4-dichlorobenzene also exceeded the control limit due to a lower recovery in the MSD analysis.

Some samples in this case were diluted for analysis due to large amounts of extractable material present in the sample extracts. When analyzed, sample 26-8281 yielded concentrations of dimethylphthalate and butylbenzylphthalate that exceeded linear range. This sample extract was diluted and reanalyzed accordingly. All data have been submitted.

Surrogate recoveries for sample 26-8286 were low, although they all fell within required control limits.

An additional data reporting flag was used for some samples in this case. Where benzo(b) and benzo(k)fluoranthene were detected with no chromatographic resolution which would allow them to be quantitated separately, an 'X' flag was used to denote that the value reported represents the total of these two compounds.

Some analyte peaks on the data system quantitation reports have been manually integrated because of irregular peak shape. All manual integrations have been initialled and dated by the analyst.

Pesticide/PCB Fraction:

Surrogate Recovery:

All surrogate recovery values from this sample set were within control limits except the recoveries of TCMX in sample 26-8285 and of decachlorobiphenyl in sample 26-8280, which were slightly low on one column only, and the recovery of decachlorobiphenyl from sample 26-8283, which was slightly high on one column.

Spike Recovery:

All spike recoveries from 26-8282MS/MSD were within control limits.

Calibration:

The final calibration verification check (PEM06) was marginally out of control (low) for the analytes 4,4'-DDT and methoxychlor. All other calibration standards were in control.

Instrument Blanks:

Instrument blanks numbered PIBLK01 through PIBLK06 were analyzed with this sample set and reported using a water default basis.

Florisil Check:

A florisil cartridge recovery check was analyzed on 06/13/91. All pesticide analytes and surrogates yielded satisfactory recoveries. The recovery of 2,4,5-trichlorophenol (38%) exceeded the control limit.

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940 S. Harney
Seattle, WA 98108

Sample Results:

Target analytes were reported on Forms 1D using the data flags "J" and "P" to qualify the confirmation of analytes in certain situations.

A 'J' flag indicates that the analyte was confirmed at a level below (but not less than half of) the reported detection limit.

A 'P' flag indicates that the analyte was confirmed, but that there was a difference of >25% between the concentration values calculated from each column (often due to matrix effects). The lower value is always reported.

SPECIFIC REMARKS ON INORGANIC ANALYSES:

Holding Time Compliance:

Laucks calculates holding time compliance for inorganic determinations using the date on which reportable data were acquired.

Miscellaneous:

The following analytes do not have a Contract Laboratory Program holding time. The holding times tabulated below derive from the relevant EPA methods and are applicable when the sample was appropriately preserved and/or cooled. All samples submitted followed the preservation guidelines unless explicitly noted otherwise.

Analyte	Holding Time	Violations
TOC	28 days (in water)	none
Grain Size	none	none

Total Organic Carbon:

No comments.

Grain Size:

No comments.

Table A-1. Detection limits for volatiles not found in sediments from Bremerton storm drains. (μg/kg dry weight)

Site	O	W	I	H	K	Y	G	A
Lab Number	8280	8281	8282	8283	8284	8285	8287	8290
Chloromethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Bromomethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Vinyl Chloride	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Chlorethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Carbon disulfide	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1-Dichloroethene	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1-Dichloroethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1-Dichloroethene (Total)	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Chloroform	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,2-Dichloroethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1,1-Trichloroethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Carbon Tetrachloride	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Bromodichloromethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,2-Dichloropropane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
cis-1,3-Dichloropropene	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Trichloroethene	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Dibormochloromethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1,2-Trichloroethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
trans-1-3-Dichloropropene	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Bromoform	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
4-Methyl-2-pentanone	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
2-Hexanone	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
Tetrachloroethene	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U
1,1,2,2-Tetrachloroethane	14 U	27 U	12 U	13 U	14 U	120 U	14 U	13 U

Qualifiers

U = Detection limit

Table A-2. Detection limits of semi volatiles and pesticides not found in sediments from storm drains in Bremerton (All values µg/kg dry weight).

Site	O	W	I	H	K	Y	G	A
Lab number	8280	8281	8282	8283	8284	8286	8287	8290
SEMI-VOLATILES								
Phenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
bis(2-chloroethyl)ether	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2-Chlorophenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
1,3-Dichlorobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2,2-oxybis(1-choropropane)	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
N-Nitroso-di-n-propylamine	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Hexachloroethane	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Nitrobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Isophorone	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2-Nitrophenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2,4-Dimethylphenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
bis(2-chloroethoxy)methane	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2,4-dichlorophenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
1,2'4-Trichlorobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
4-chloroaniline	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Hexachlorobutadiene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
4-Chloro-3-methylphenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Hexachlorocyclopentadiene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2,4,6-Trichlorophenol	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2,4,5-Trichlorophenol	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
2-Chloronapthalene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
2-Nitroaniline	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
2,6-Dinitrotoluene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
3-Nitroaniline	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
2,4-dinitrophenol	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
4-Nitrophenol	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
2,4-Dinitrotoluene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Diethyphthalate	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
4-Chlorophenyl-pheylether	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
4-Nitroaniline	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
4,6-Dinitro-2-methylphenol	5500 U	11000 U	990 U	5300 U	2200 U	4100 U	2200 U	5100 U
4-Bromophenyl-phenylether	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
Hexachlorobenzene	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
3,3'-Dichlorobenzidine	2300 U	4500 U	410 U	2200 U	900 U	1700 U	900 U	2100 U
PESTICIDES								
beta-BHC	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	2.1 U	2.2 U	2.3 U
delta-BHC	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	2.1 U	2.2 U	2.3 U
Endosulfan I	2.3 U	4.6 U	2.1 U	2.1 U	2.1 U	2.1 U	2.2 U	2.3 U
Endosulfan sulfate	4.5 U	8.9 U	4.1 U	4.1 U	4.1 U	4.1 U	4.3 U	4.5 U
Endrin aldehyde	4.5 U	8.9 U	4.1 U	4.1 U	4.1 U	4.1 U	4.3 U	4.5 U
Toxaphene	230 U	460 U	210 U	210 U	210 U	210 U	220 U	230 U
Aroclor-1016	45 U	89 U	41 U	41 U	41 U	41 U	43 U	45 U
Aroclor-1221	92 U	180 U	83 U	83 U	83 U	83 U	88 U	92 U
Aroclor-1232	45 U	89 U	41 U	41 U	41 U	41 U	43 U	45 U
Aroclor-1242	45 U	89 U	41 U	41 U	41 U	41 U	43 U	45 U
Aroclor-1260	45 U	89 U	41 U	41 U	41 U	41 U	43 U	45 U

U = No compound found at detection limit shown.